DOCUMENT RESUME

ED 220 803 CS 006 792

AUTHOR Maria, Katherine; MacGinitie, Walter H.
TITLE Congruence of Prior Knowledge and Text Information as a Factor in the Reading Comprehension of Middle-Grade Children. Technical Report #16.
INSTITUTION Columbia Univ., New York, N.Y. Research Inst. for the Study of Learning Disabilities.
SPONS AGENCY Office of Special Education and Rehabilitative Services (ED), Washington, DC.
PUB DATE 81
CONTRACT 300-77-0491
NOTE 44p.

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Congruence (Psychology); Intermediate Grades; *Prior Learning; *Reading Comprehension; *Reading Difficulties; *Reading Processes; *Reading Research
IDENTIFIERS Text Factors; *Text Structure

ABSTRACT

Two studies using the same texts and procedures but different experimental designs (1) evaluated an instrument designed to identify children who overrely on their prior knowledge in the interpretation of written text, and (2) investigated how degree of congruency of information interacts with degree of explicitness and level of staging to affect the comprehension of middle-grade children. The subjects of the first experiment, 164 fifth and sixth graders, read four types of short texts, each of which contained two pieces of target information, one judged congruent with their prior knowledge and one judged incongruent, presented implicitly or explicitly at a different stage of the text. Although the reliability of the scores was low, the results did seem to isolate a group of children that used a nonaccommodating strategy when confronted with incongruent information. Subjects of the second experiment were 145 fourth and seventh graders from the same school who had answered questions without texts previously as a check on the congruency of the target information in the texts. Although this study's finding--that incongruent information was more difficult for both grade levels--cannot be interpreted with confidence, the data were consistent with the hypothesis that incongruent information is more difficult to process as a result of prior knowledge sources conflicting with sources in the text. This finding has implications for judging the difficulty level of texts presented to children. (JL)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

RESEARCH INSTITUTE FOR THE STUDY OF LEARNING DISABILITIES
Teachers College, Columbia University

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

Minor changes have been made to improve reproduction quality.

Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

ED220803

CONGRUENCE OF PRIOR KNOWLEDGE AND TEXT INFORMATION AS A FACTOR IN THE READING COMPREHENSION OF MIDDLE-GRADE CHILDREN

Katherine Maria
Walter H. MacGinitie

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Kate Hathaway

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

CS006792

Technical Report #16

1981

The Research Institute for the Study of Learning Disabilities at Teachers College, Columbia University is supported by a contract (300-77-0491) with the Office of Special Education, Department of Education through Title VI-G of Public Law 91-230.

The Research Institute is predicated on the assumption that many of the problems exhibited by learning disabled children arise because of difficulties they manifest in information-processing. The overall goals of the Institute are to investigate the nature of such information-processing difficulties and, on the basis of the findings of these investigations, to develop effective and efficient instruction for children with learning disabilities.

The Institute is composed of five independent task forces that focus on specific academic skill areas fundamental to the school curriculum: basic reading and spelling, reading comprehension, arithmetic, and study skills. All of the task forces are dedicated to the identification of specific disabilities in these skill areas and to the development of effective remedial instruction.

Principal Investigators

N. Dale Bryant, Ph.D.
Jeannette Fleischner, Ed.D.
Walter MacGinitie, Ph.D.
Margaret Jo Shepherd, Ed.D.
Joanna Williams, Ph.D.

Institute Director

Frances P. Connor, Ed.D.

Additional information on research activities of the Institute may be obtained by writing:

Research Institute for the Study of Learning Disabilities
Box 118
Teachers College, Columbia University
New York, N. Y. 10027

RESEARCH INSTITUTE FOR THE STUDY OF LEARNING DISABILITIES
Teachers College, Columbia University

CONGRUENCE OF PRIOR KNOWLEDGE AND TEXT INFORMATION AS A FACTOR IN THE READING COMPREHENSION OF MIDDLE-GRADE CHILDREN

Katherine Maria
Walter H. MacGinitie

Technical Report #16

1981

Abstract

Two studies were conducted that investigated congruency of text information with prior knowledge as a factor in the reading comprehension of middle grade children. In both studies children read texts containing both congruent and incongruent information. New information that contradicted common beliefs of children similar to the subjects of the study was labelled incongruent information while new information similar to the prior knowledge of the children was labelled congruent.

The purpose of the first study was to develop an instrument to identify fifth and sixth-grade children who overrely on prior knowledge in their comprehension of text. Large differences between comprehension scores for congruent and incongruent information were considered an indication of the use of a strategy of overreliance on prior knowledge. A group was identified that found congruent information much easier than incongruent information. Although many of the differences found could be attributed to chance factors, similarities among the children in the group suggested that part of the variance of the difference score might be attributable to special difficulty that these children experienced with incongruent information.

The purpose of the second study was to investigate how degree of congruency interacts with degree of explicitness and level of staging of information to affect the reading comprehension of fourth and

seventh graders. Texts containing both incongruent and congruent information were presented in explicit and implicit versions with incongruent information staged either high or low in the texts.

Incongruent information was found to be more difficult than congruent information for children in both grades. Explicitness of congruent information made no difference to fourth graders, but incongruent information was more difficult when it was implicit. In Grade 7, both kinds of information were affected by the degree of explicitness, so that implicitness of incongruent information presented no special difficulty. Staging had no effect in either grade.

CONGRUENCE OF PRIOR KNOWLEDGE AND TEXT INFORMATION AS A FACTOR IN THE READING COMPREHENSION OF MIDDLE-GRADE CHILDREN

Katherine Maria, and Walter H. MacGinitie

In the past, researchers in the field of learning disabilities have mainly been concerned with determining factors that may be responsible for difficulty in decoding. There is now developing an interest in the relation between learning disabilities and difficulties in reading comprehension (e.g., Weaver, 1978; Weaver & Dickinson, 1979). Past research in learning disabilities has sought to define such disabilities on the basis of deficiencies in basic processes (e.g., Johnson & Myklebust, 1967) or neurological differences (e.g., Mattis, French, & Rapin, 1975). Recent work has begun to focus on the role of text processing strategies (e.g., Maria & MacGinitie, 1980). The focus on strategies has been stimulated by a growing appreciation of the complexity and interactive nature of the reading process.

Several theorists (e.g., Rumelhart, 1977; Kintsch, 1979) have devised models of the interactive processing in reading. Earlier models, like that of Gough (1972), suggested that understanding a text resulted from the reader's progression through a hierarchy of processes, from identifying features to the recognition of letters and words and finally to a processing of sentences and text. Interactive models view readers as engaging in parallel processing at many levels at the same time. In these models, processing moves in two directions: bottom-up, as in the earlier models, and also top-

down, so that knowing what the story is about and identifying letters in a word contribute simultaneously to the identification of a particular word. In an important sense, this more sophisticated understanding of reading blurs the distinction between decoding and comprehension, since each is seen as interacting with the other.

Kintsch's (1979) interactive model assumes the processes of word identification, access of word meanings, and syntactic analysis as bottom-up processes going on at the same time as top-down processes. Top-down processes are based on factors like the reader's goal for reading, his world knowledge and the schemata that structure the text. These top-down processes are extremely important, because usually a higher-level process will make a decision as to the particular meaning to be encoded on the basis of context long before lower-level analyses are completed (Kintsch, 1977; Marslen-Wilson & Welsh, 1978).

The interactive nature of the reading process and the limited capacity of memory force readers to allocate their resources or, in other words, program their processing. This programming involves the use of particular strategies, so that a reading problem may result from using an inappropriate strategy for a particular reading task. It is possible that in some children a deficit in basic processing may lead to the use of an inappropriate strategy. On the other hand, a reader may use a strategy that is not ordinarily optimal for a particular task but that compensates somewhat for a basic processing deficit.

The ultimate goal of the identification of causes of disabilities in reading performance is to suggest methods of remediation to improve that performance. Remedial programs designed to improve deficits in basic processing (e.g., Frostig & Horne, 1964) have generally improved performance in the tasks presumed to require the particular type of processing (e.g., figure ground perception) but have not improved reading performance (Hammill & Bartel, 1975). The strategies a reader uses are more directly related to the reading process. Therefore, a search for causation at this more proximate level may be more useful in designing procedures to improve reading performance.

The work of Spiro and his associates at the Center for the Study of Reading (Spiro, 1979, 1980; Spiro and Smith, in press; Spiro & Tirre, 1980) has involved the classification of poor readers in terms of the strategies they use in reading comprehension. It is important to note that Spiro's classification is a classification of poor readers. It is difficult to classify good readers according to the strategies they use, because there is evidence that they are flexible and adjust their strategy to fit the particular reading task (Frederiksen, 1975). It appears that poor readers are less likely to do this but may use a particular strategy whether it is task appropriate or not.

Spiro (1979) argues for a two-tiered approach to individual differences in reading comprehension. One tier involves the component skills in comprehension; the other is concerned with the manifestation of skill deficiencies in reading comprehension style. Confronted with

a skill deficiency, two options are available to readers. They may persevere in the problem area or they may shift processing resources in an effort to compensate for the problem. For example, there are readers who decode laboriously but persevere with their decoding efforts. Given the limitation on information processing capacity, this behavior may produce a "bottleneck" in the system (Perfetti & Lesgold, 1978). The result may be that higher-order, more knowledge-based processes, will not be utilized. On the other hand, readers who decode laboriously may prefer to avoid the decoding tasks and rely on prior knowledge to guess what is likely to occur in the text. In other words, the same deficiency may lead to either a text-based or a knowledge-based comprehension style.

Spiro (1979) has found evidence to support the view that poor readers tend to over-rely either on top-down (knowledge-based) or bottom-up (text-based) processing. The individual poor reader, however, does not over-rely on top-down processing at one time and over-rely on bottom-up processing at another time (Spiro & Smith, in press). The poor reader who over-relies on bottom-up processing has difficulty seeing beyond the details to the total meaning. The poor reader who over-relies on top-down processing decides what the passage is about and ignores details that might disconfirm his hypothesis.

Spiro (1979, 1980) is one of the few investigators to suggest that using one's prior knowledge could interfere with comprehension. Most researchers (e.g., Pearson, 1979; Bower, Black, and Turner, 1979)

have focused on the importance of prior knowledge as an aid to understanding rather than a source of interference. Prior knowledge is important because it is necessary for inferencing. There is evidence that inferencing is used more in the comprehension of text than had previously been recognized (Clark & Clark, 1977; Nix, 1977). Many times, inferences are absolutely necessary in order to understand a passage at all. These inferences have been referred to as logical (Warren, Nicholas, & Trabasso, 1979) or enabling inferences (Hildyard & Olson, 1978). Even in cases where inferences are not necessary to make the text coherent, they may serve to instantiate the information concretely (Anderson & Ortony, 1975) or allow the reader to process the text to a deeper level (Craik & Lockhart, 1972) and thus serve as an aid to memory.

Several studies done with poor readers (Marshall & Glock, 1977-1978; Tierney, Bridge, & Cera, 1978-1979; Weaver & Dickinson, 1979) found that the poor readers made use of their prior knowledge as evidenced by a substantial amount of inferencing in their recalls. Weaver and Dickinson (1979) categorized inferences as either major or minor. In major inferences entire sentences were added or replaced while in minor inferences only words or phrases were changed. The recalls of the poor readers in the Weaver and Dickinson study contained more major inferences than the recalls of the normal readers.

Other studies that have analyzed the nature of inference have found that college-age poor readers do make inferences from what they

read but that their inferences differ from those of good readers. Tierney, Bridge, and Cera (1978-1979), using Frederiksen's (1977) Taxonomy of Text-Based Inferences, found that all readers engage in a substantial amount of inferential processing, although good readers include more explicit and inferred information in free and probed recall. The inferences made by the poor readers tended to substitute superordinate concepts for subordinate concepts, which contributed to the lack of specificity in their recalls. Good readers tended to make more causal and conditional inferences. College-age students defined as not so fluent readers in a study by Marshall and Glock (1977-1978) also did a substantial amount of inferencing, which, on some occasions, resulted in recalls that were contradictory to the text. These studies suggest that many poor readers do use inferences to construct meaning from text but that they may use prior knowledge somewhat differently than good readers in this process.

The interactive compensatory model (Spiro, 1979; Stanovich, 1980) may provide an explanation for this conclusion. It is true that every reader must be able to relate the text information to his prior knowledge in some way. However, interactive models of reading (Rumelhart, 1977; Kintsch, 1978; Stanovich, 1980) suggest that it is the task of the reader to balance input from other levels of processing such as orthography, syntax, and text structure with his prior knowledge. The reader must know when and how to use prior knowledge to interpret text. The nature of the relationship between text information and

prior knowledge can be one of similarity or one of difference. In this paper, text information similar to the information in the reader's prior knowledge will be labeled congruent information, and text information that is different from the reader's prior knowledge will be labeled incongruent information.

The weight given to prior knowledge in the interactive processing of information should differ according to the nature of the information. Relying on prior knowledge to process congruent information would be efficient. Deficiencies in other knowledge sources such as word recognition and linguistic ability would be masked, since all knowledge sources would be working together. In fact, this lack of conflict between knowledge sources should make congruent information easier to process than incongruent information for all children. One of the studies described below provided a test of this hypothesis.

On the other hand, one of the main reasons for learning to read is so that one can read to acquire new information. At times, this new information may conflict with the reader's prior knowledge. Resolving this conflict so that one's schema can accommodate the new incongruent information seems to involve giving more weight to textual cues than to one's prior knowledge. Thus, we hypothesized that children who over-rely on prior knowledge do not accommodate their schemata to this new information and so may be distinguished by differences in their ability to comprehend congruent and incongruent information.

Numerous studies (e.g., Guzak, 1972; Kintsch, 1974; Goetz, 1977)

have found explicit information easier to comprehend than implicit information. Yet in an informal study that was preliminary to the studies reported here (Maria & MacGinitie, 1980), congruency of information appeared to affect the children studied more than did explicitness of the information.

Although we must all use what we already know to help us understand what we read, Bobrow and Norman (1975) have suggested that the efficient processor is one who focuses on the unexpected and processes the expected superficially. There is evidence that efficient readers do process expected information superficially (Spiro & Esposito, 1977). The poor readers who were the focus of the preliminary study did not. It appeared that they assimilated the new information to their prior knowledge schema but failed to accommodate their schema to the new information. Thus these children can be described as using a non-accommodating strategy (Maria & MacGinitie, 1980).

Children who make use of this non-accommodating strategy do not seem to learn well from written language. They are disabled in the comprehension of written language when the text contains new information. Yet they do learn. The fact that they are of adequate intelligence and can learn information presented orally in class by their teachers is evidence of this. In addition, they do not appear to have any overt language problems, and they appear to be more verbal than other poor readers.

In the preliminary investigation, the Information, Similarities, Vocabulary, and Comprehension subtests of the WISC-R were administered

to several of the subjects who used a non-accommodating strategy. All these children scored at least average range or higher on these verbal subtests of the WISC-R (Kaufman, 1979).

On intelligence tests such as the WISC-R, previously acquired knowledge and ability to apply that knowledge is sampled by asking the child short oral questions that the child also responds to orally. The child is asked questions on the Information subtest like, "Why does oil float on water?"; questions on the Similarties subtest like, "How are beer and wine alike?"; questions on the Vocabulary subtest like, "What does nonsense mean?"; and questions on the Comprehension subtest like, "Why are criminals locked up?" Most of these questions could be answered by children who are alert to the world around them, able to acquire knowledge by means of oral language, and able to make use of that knowledge.

Another finding in the Weaver and Dickinson (1979) study may help account for the difficulty these children have in learning from written language. Weaver and Dickinson suggested that the problem of the poor readers they had studied might be due to a lack of balance between their use of certain linguistic cues called cohesive markers and their use of prior knowledge. Cohesive markers were defined by Halliday and Hasan (1976) as words that signal relationships between sentences and even paragraphs. These words include pronouns, conjunctions, time words like then or later, place terms like here and there as well as

many others. Many of these markers are deictic terms that force the child to take account of the framework set by the text. Cohesive markers were apparently not salient for poor readers studied by Weaver and Dickinson (1979), for they remembered and introduced relatively few of these markers in trying to recall a text. It is likely that cohesive markers and deictic terms, as well as other structural elements, are more important in written language where there is a lack of shared extralinguistic context between the writer and the reader and where the task of the reader is to get the ideational meaning more than the personal meaning (Hildyard & Olson, 1978). Thus, more subtle linguistic problems might affect comprehension of the more complex written language by these children and cause them to over-rely on an alternate knowledge source, i.e., rely on prior knowledge.

Many of the texts used in the preliminary investigation made extensive use of cohesive markers and other deictic terms in "explicitly" stating information. Such supposedly explicit information would be difficult for children who fail to take account of these linguistic cues.

Some of these texts also stated congruent information at the outset of the text with incongruent information coming later in the text. To put it another way, congruent information was staged high and incongruent information was staged low. Clements (1979) has suggested that the level of staging of a piece of information depends on the position at which it is introduced in the text, whether it is old or new information, and whether it is coordinated or subordinated to

a previous topic. He found evidence that information staged higher in the text is comprehended and recalled better than information staged lower in the text.

A study by Kimmel (1981) was consistent with the Clements (1979) results. Kimmel found that some poor readers form an interpretation of the early portion of a text and try to interpret all subsequent text in conformity with the initial interpretation. These poor readers also use a non-accommodating strategy, in this case, over-relying on their prior knowledge of text structure rather than text content.

In order to show that it is the congruency of the information that affects the group of poor readers discussed here, it will eventually be necessary to demonstrate that this effect is not simply another example of inflexible processing studied by Kimmel (1981). There is evidence that when normal readers have heightened interest in, or very strong feelings about, some part of the text message, the effect of staging will not be evident in their recalls (Clements, 1979). If some poor readers focus on what they already know, regardless of where it is staged in the text, this congruent information will be more salient for them than incongruent information. If they are over-relying on their prior knowledge, then incongruent information should be more difficult even when it is staged higher in the text.

The present paper reports on two investigations. The primary purpose of Experiment I was to evaluate an instrument designed to identify children who over-rely on their prior knowledge in the inter-

pretation of written text--children who use a non-accommodating strategy. The primary purpose of Experiment II was to investigate how degree of congruency of the information interacts with degree of explicitness and level of staging to affect the comprehension of middle-grade children.

Experiment I

Method

Subjects. The subjects were 164 students in the fifth and sixth grades of a suburban parochial school near New York City. They were all from middle class families with 10% black and only five children for whom English was a second language. Students from these grades were selected to allow for comparisons between the results of this study and those of the Kimmel (1981) study that used the same subjects.

Standardized test scores on the SRA Achievement Tests, Levels E and F, Form 2, given to the children two months previous to the study, were available as well as IQ scores on the Otis-Lennon Mental Ability Test, Elementary Level II, Form J. Children in the fifth grade had taken the Otis-Lennon Mental Ability Test several months previously. The IQ scores of the sixth-grade children were from the test given the previous year.

Materials. Twenty-eight expository texts were constructed. Each text was about 150 words long and concerned a topic from either science or social studies. An overriding concern in the construction of these texts was their naturalness. Every attempt was made to construct texts that might well be found in a middle grade textbook. Every effort was also made to use words that were familiar to the children and that posed few decoding problems. Each text was constructed around two pieces of target information. Both pieces of information were judged likely to be new information to children of this age. One new piece of information was judged to be congruent with the children's prior knowledge schemata for the topics of the paragraph. This piece of information was designated congruent information. The other piece of information was assumed to contradict some information in the children's prior knowledge schemata. This piece of information was designated incongruent information. In some texts, both pieces of target information were explicitly stated while in others they were only implied.

The texts consisted of two or three paragraphs. In some texts the incongruent information was staged high (Clements, 1979), i.e., contained in the first paragraph, and the congruent information was staged low, i.e., contained in the second or third paragraph. In other texts this situation was reversed.

These manipulations resulted in four different types of texts. Descriptions of four types of texts and an example of each type are given below. In the example, it was assumed that the information that gasoline is derived from once-living organisms is not consistent with the children's perception of gasoline as a non-living chemical liquid used to power cars.

1. A text in which the target information was explicitly stated, with incongruent information staged high and the congruent information staged low (E Inc H/E Con L).

> Coal and oil are two of today's major sources of energy. Much of the oil we get from the earth is made into gasoline. The gasoline that powers our cars was at one time alive. It is made up of tiny creatures that once swam and crawled in ancient seas long before humans arrived on earth. The creatures were covered by sand and rock. Under heat and pressure, they turned into oil. We do not have to mine for oil. We drill wells and pump it out of the ground.
>
> Coal was also formed by pressure, but it must be mined. Coal looks like black rock. It is a very important source of fuel for making electricity. We need so much coal today that we now use two ways of mining it--tunneling and strip mining. In strip mining, huge machines cut away enormous slices of earth to get at the coal underneath. In some places, the older way of mining, tunneling into the earth, is still used. Tunneling is a less destructive method of mining.

2. A text in which the target information was explicitly stated, with the incongruent information staged low and the congruent information staged high (E Inc L/E Con H).

> Coal and oil are two of today's major sources of energy. Coal must be mined. Coal looks like black rock. It is a very important source of fuel for making electricity. We need so much coal today that we now use two ways of mining it--tunneling and strip mining. In strip mining huge machines cut away enormous slices of earth to get at the coal underneath. In some places, the older way of mining, tunneling into the earth, is still used. Tunneling is a less destructive method of mining.

Coal and oil are both found underground. Much of the oil we get from the earth is made into gasoline. The gasoline that powers our cars was at one time alive. It is made up of tiny creatures that once swam and crawled in ancient seas long before humans arrived on earth. These creatures were covered by sand and rock. Under heat and pressure they were turned into oil. We do not have to mine for oil. We drill wells and pump it out of the ground.

3. A text in which the target information was implicitly stated, with the incongruent information staged high and the congruent information staged low (I Inc H/I Con L).

Coal and oil are two of today's major sources of energy. Much of the oil we get from the earth is made into gasoline. The gasoline that powers our cars is made up of tiny creatures that once swam and crawled in ancient seas long before humans arrived on earth. These creatures were covered by sand and rock. Under heat and pressure, they were turned into oil. We do not have to mine for oil. We drill wells and pump it out of the ground.

Coal was also formed by pressure, but it must be mined. Coal looks like black rock. It is a very important source of fuel for making electricity. We need so much coal today that we now use two ways of mining it: tunneling and strip mining. In the newer way, huge machines cut away enormous slices of earth to get at the coal underneath. In some places, the older way of mining, tunneling into the earth, is still used. Tunneling is a less destructive method of mining.

4. A text in which the target information was implicitly stated, with the incongruent information staged low and the congruent information staged high (I Inc L/I Con H).

Coal and oil are two of today's major sources of energy. Coal must be mined. Coal looks like black rock. It is a very important source of fuel for making electricity. We need so much coal today that we now use two ways of mining it--tunneling and strip mining. In the newer way huge machines cut away enormous slices of earth to get at the coal underneath. In some places, the older way of mining, tunneling into the earth, is still used. Tunneling is a less destructive method of mining.

Coal and oil are both found underground. Much of the oil we get from the earth is made into gasoline. The gasoline that powers our cars is made up of tiny creatures that once swam and crawled in ancient seas long before humans arrived on earth. These creatures were covered by sand and rock. Under heat and pressure, they turned into oil. We do not have to mine for oil. We drill wells and pump it out of the ground.

For each text, two questions were constructed, one concerning the congruent target information and one concerning the incongruent target information. The questions were multiple-choice questions with either two or three answer choices:

Gasoline was once

( ) alive
( ) water
( ) sand and rock

Strip mining is

( ) cutting away the earth with machines
( ) pumping
( ) tunneling into the earth

In the case of questions with two choices, one choice was judged to be more congruent with the child's prior knowledge schema for the topic while the other choice was judged incongruent. Thus, for congruent target information the congruent choice was the correct answer; for incongruent target information the incongruent choice was the correct answer. Both answer choices contained words found in the text. Whenever possible, three choices were given in order to reduce the effects of guessing. If there was a third choice, it was always judged congruent with the child's prior knowledge schema

but usually contained words not found in the text. The choices were ordered randomly through the use of a random numbers table. The two questions were ordered in the same order as the order of the target information in the text.

Using a table of random numbers, a random order of the four text conditions was generated, with the restriction that there were 7 instances of each text condition within each sequence of 28 and no more than 2 instances of a condition were adjacent. Texts were also randomly ordered so that the order of conditions and the insertion of a particular text in a particular condition were both random.

In order to confirm the judgments about the congruency or incongruency of the target information with the children's prior knowledge, 147 students from grades four and seven in the same school were given the questions without the texts. The questions were randomly ordered and were arranged, six questions per page, with the provision that no two questions on the same topic would be adjacent. The pages were then arranged in four different random orders with the same provision. The children were tested in class groups of about 30. They were given the questions in a booklet containing the following instructions on the first page.

INSTRUCTIONS:

> This booklet contains a number of questions about many different subjects. You may know the answers to some of the questions, but you will certainly not know the answers to all of them.
>
> If you don't know the answer, we would like you to guess. We are interested in finding out which answers children would guess to be the right answer. Don't just pick out any answer. Think about it and make the best guess you can.

The experimenter did three samples with the children, informing them whether their guesses were correct or incorrect. Two of the samples had a correct answer that was presumed to be incongruent, and one had an answer that was presumed to be congruent with the children's prior knowledge.

The children's answers to the questions were scored correct or incorrect on the basis of the texts that they were designed to accompany. Any incongruent question that received more than 30% correct guesses was judged not to be truly incongruent, and the text that accompanied that question was dropped from the analysis of the grade-five and grade-six responses. This resulted in the removal of 10 texts leaving a total of 18 texts, 3 of the E Inc H/E Con L type and 5 of each of the other three types.

Procedure

Children were tested in class groups of about thirty. They received booklets that contained each text on a separate page. The questions followed the text on the same page. Each booklet contained the following instructions, which were read to the children by the experimenter.

> This booklet contains a passage on each page. Each passage is followed by two questions. You are to read each passage and mark an X in the parentheses ( ) in front of the best answer to each question.
>
> Please ask for help with any word that you cannot read, and take as much time as you need.
>
> Let's turn to the first sample and do it together.

The experimenter then went over two samples with the children. In one of the samples the target information was explicitly stated while in the other it was implied. This was pointed out to the children.

All the children finished within the 45-minute class period. The materials had been prepared at a readability level appropriate for the children, and very few children asked for assistance in identifying words. Children's answers were scored "1" if correct or "0" if incorrect.

Results

The raw scores for congruent and incongruent subtests were separately transformed into standard scores. The correlation of scores between the congruent and incongruent subtests was .624. Reliabilities of congruent and incongruent subtests, of the total test, and of the difference between congruent and incongruent scores are shown in the Table 1.

Table 1

Standard Score Reliabilities

Score	Reliability
Incongruent	.790
Congruent	.662
Total	.836
Difference	.271

The reliabilities of the congruent and incongruent subtests were used to compute, for each subject, an estimated true standard

score (regressed standard score) for the congruent questions and an estimated true standard score for the incongruent questions. A difference score was then computed for each subject.

Since children with a non-accommodating reading strategy would be likely to be among the students with relatively low scores on the incongruent compared to the congruent items, those students with the most extreme difference scores were identified so that they could be studied diagnostically at a later time.

Because of the errors of measurement involved in the difference scores, there is a good chance of a real difference only if the observed difference is quite large. In deciding how large the difference score must be for the student to be included in the group to be studied diagnostically, a procedure suggested by Thorndike (1973) was used. A cutoff was sought such that there would be at least a 50:50 chance that the identified students would have a real difference in their reading comprehension of incongruent and congruent information. Thorndike's procedure indicated that a difference of approximately 1.5 standard deviations between incongruent and congruent subtest scores would serve as an appropriate cutoff, identifying 4.18% of the tested group. Of these cases, about half (2.12%) should represent chance occurrence and half (2.06%) should represent real differences (or, in Thorndike's terms, the betting odds would be 206:212, or about 1:1).

Those children whose difference scores were at least 1.5 standard deviations above or below the mean difference score were selected for further analysis. There were 13 subjects with

high positive difference scores, i.e., their incongruent score was much lower than their congruent score. This was the group of interest. This group had a mean difference of 13.39 with a standard deviation of 2.65. On the screening test, their raw score mean total correct was 21.38 with a S.D. of 3.65. The lowest score was 15.76 and the highest 28.76.

There were also eight subjects with high negative difference scores. This group had a mean difference score of -11.30 with a standard deviation of .77. While this high negative difference group showed less variability than the high positive difference group with regard to their difference scores, in every other respect they were a much more varied group than the high positive difference group. They had a higher mean total correct ($\bar{X}$ = 26.14) but the standard deviation of the total for this group was more than twice as large (SD = 7.95) as that of the high positive difference group (SD = 3.65). The range of total scores is another indication of the extreme variability of this negative difference group. The lowest total score was 11.76 and the highest 34.76.

Means and standard deviations of IQ scores from the Otis-Lennon Mental Ability Test, Elementary Level II, form J, are shown in Table 2. Again the mean of the high negative difference group was slightly higher, and this time the standard deviation of this group was almost three times greater than that of the high positive difference group.

NCE scores (normalized standard scores with a mean of 50 and

S.D of 21.06), from Levels E and F, Form 2, of the SRA Achievement series (Science Research Associates, 1978) were available for the children involved in the study. The scores of the two groups under discussion are also summarized in Table 2.

Table 2

Mean IQ and Achievement Scores of Children with Large Congruent-Incongruent Differences

	High Positive Group		High Negative Group	
	Mean	SD	Mean	SD
Otis-Lennon IQ	101.08	6.60	110.57	19.10
SRA Scores				
Composite	44.77	5.54	61.00	26.97
Vocabulary	51.46	15.87	53.63	17.83
Comprehension	40.69	9.48	61.38	20.89
Total Reading	45.23	10.13	58.50	20.44
Math Concepts	50.84	8.47	64.50	25.63
Math Problems	51.69	12.71	60.00	21.47
Math Total	48.62	7.27	63.00	26.93
Usage	41.15	10.22	57.63	25.59
Spelling	35.23	15.92	46.00	22.92

On every SRA subtest the mean of the high negative difference group is higher than that of the high positive

difference group. However, the standard deviations of the high negative difference group are also extremely high, an indication of the wide range of ability in this group. One subtest, vocabulary, is an exception to this pattern. On this subtest, the means of the two groups, as well as the standard deviations, are quite similar. Because of this and the wide difference between the two groups in performance on the comprehension subtest, both groups have differences between their vocabulary and comprehension scores. The high positive difference group has a mean vocabulary score higher than their mean comprehension score, while the high negative difference group has a mean comprehension score greater than their mean vocabulary score. The very high standard deviation of comprehension score for the high negative difference group (SD = 20.89) suggests that for the high negative difference group, the difference between comprehension and vocabulary is not very consistent across subjects. In fact, this is true. Of the eight subjects in the high negative difference group, only three had comprehension scores more than 10 points higher than their vocabulary scores. (However, one of these subjects had a comprehension score 34 points higher than his vocabulary score.) In addition, one subject in this group had a substantial difference in the opposite direction, i.e., his vocabulary score was 14 points higher than his comprehension score.

In the high positive difference group, on the other hand, while the size of the difference between the vocabulary and comprehension

scores varied, every subject but one had a vocabulary score greater than his/her comprehension score. The one exception had a comprehension score only six points higher than his vocabulary score.

Discussion

The low reliability of the difference scores ($r = .271$) indicates that the difference scores have a large error component. Indeed, the extreme variability and small size of the high negative difference group suggest that these negative differences are most likely due to chance factors. However, the high positive difference group was larger and far less variable on just about every factor than the high negative difference group. It is possible, therefore, that a major part of the true variance of the difference score is contributed by the scores of the children in the high positive difference group. These children are alike in several other ways, and many of them may consistently have special difficulty with incongruent information in written text.

The children in this high positive difference group were all of average intelligence. The mean IQ of this group was 101, and the lowest IQ score of any child in the group was 90. It had been hypothesized that children prone to the use of a non-accommodating strategy of overreliance on prior knowledge would score at least in the average range on the WISC-R, since the use of such a strategy would serve them well on an IQ test that measures what an individual has already learned. The fact that this high positive difference group had IQ's in the average range on an IQ test (Otis-Lennon Mental Ability Test)

which included the burden of reading the test (a factor not found in the WISC-R) gives further support to this hypothesis.

Cromer (1970) suggested the existence of a group of poor readers who have special difficulty with comprehension of connected text rather than word recognition difficulties. He indicated that such a group would be characterized by vocabulary scores that were higher than their comprehension scores. The high positive difference group on this study appeared similar to this group described by Cromer, since their vocabulary scores are higher than the comprehension scores. Overreliance on prior knowledge may be a characteristic of children whose vocabulary scores indicate a good background of knowledge and whose comprehension scores indicate difficulty in understanding written text.

The results of this study suggest that the instrument developed is capable of identifying children who might be considered to use a non-aecommodating strategy since they find information that is incongruent with their prior knowledge much more difficult to process. The fact that the standardized test scores of the children fall within the average range suggests that this type of non-accommodating strategy may characterize low-average rather than poor readers.

Further investigation is needed before placing any degree of confidence in these children's use of a non-accommodating strategy. Performance on one task does not provide sufficient evidence for use of a strategy. Moreover, the minimal reliabilities of the congruent

subtest and of the difference score suggest the need for revision of the screening instrument. As a first step, however, the results of this study suggest that further investigation is warranted.

Experiment II

An independent study employing the same texts and a different experimental design was also carried out to investigate the effect of congruency of information on the comprehension of middle-grade children and to see if the effect of congruency was related to degree of explicitness or level of staging.

Method

Subjects. The subjects were 145 students in the fourth and seventh grades of the same suburban parochial school used in the first study. These were the same subjects who had answered the questions without the texts as a check on the congruency of the target information. This study was conducted more than a month later in order to reduce any connection of the two testings in the minds of the students.

Materials. The materials for this study consisted of four versions of the 18 texts used in the first study. Two texts were added for a total of 20. One of the added texts had been used as a sample in the first study. The other had an incongruent question answered correctly by only 35% of the respondents to the questionnaire, so the criterion was modified to permit inclusion of this text.

Design. This study used a mixed factorial design. Degree of explicitness and level of staging were between-subject factors, and degree of congruency was a within-subject factor. There were four different subject groups, each group receiving all the texts in one condition. The text conditions were rotated for distribution to each class group. The conditions and resulting number of subjects in each condition are listed in Table 3.

Table 3

Number of Subjects in each Text Condition

Condition	Grade	Number of Subjects
E Inc H/E Con L	4	18
	7	16
E Inc L/E Con H	4	19
	7	17
I Inc H/I Con L	4	21
	7	16
I Inc L/I Con H	4	20
	7	18

Procedures. The procedures for administration and scoring were the same as those used in the Experiment I.

Results

Kuder-Richardson Formula 20 reliabilities for the two grades combined and for each grade separately are shown. Results are listed in the Table 4. The correlation between the Incongruent and Congruent scales was .702 for both grades combined, .621 for Grade 4, and .683

for Grade 7. It can be seen that a problem with the reliability of the congruent scale occurred in the fourth grade. Otherwise, the reliabilities were quite acceptable.

Table 4

KR-20 Test Reliabilities

Scale	Grade	Reliability
Total	Combined	.870
	4	.816
	7	.871
Congruent	Combined	.715
	4	.581
	7	.726
Incongruent	Combined	.825
	4	.780
	7	.824

Since it was possible that the effects might differ according to grade, separate ANOVA's were computed for each grade. In fourth grade, there was a main effect for level of congruency $F(1,74) = 42.49$, $p < .001$). Congruent information ($\bar{X} = 12.474$) was easier than incongruent information ($\bar{X} = 10.013$) in all conditions. There was no significant main effect for condition, but there was a significant congruency by explicitness interaction. Table 5 suggests the nature of this interaction.

Table 5

Subscale Means and Standard Deviations for Four Conditions in Grade Four

Condition	Scale	Mean	SD
E Inc H/E Con L	Congruent	13.556	3.222
	Incongruent	12.278	5.686
E Inc L/E Con H	Congruent	12.158	3.[illegible]3
	Incongruent	10.263	3.509
I Inc H/I Con L	Congruent	11.714	2.986
	Incongruent	9.381	2.636
I Inc L/I Con H	Congruent	12.600	2.742
	Incongruent	8.400	4.321

The mean congruent information score did not differ greatly across the four conditions, but incongruent information was easier to comprehend in some conditions than others. When the four groups were combined into two groups--an explicit and an implicit group--the nature of the interaction was made clearer. There was again a significant main effect for degree of congruency ($F(1,76) = 41.37$, $p < .001$) and also a significant main effect for degree of explicitness ($F(1,76) = 4.13$, $p = .05$) and a significant interaction ($F(1,76) = 4.81$, $p < .05$) between congruency and explicitness.

Table 6 indicates that explicit information was easier overall, but this was primarily due to the fact that incongruent information was easier when it was stated explicitly.

Table 6

Means for Explicit and Implicit Conditions

Condition	Congruent	Incongruent	Total
Explicit	12.838	12.146	12.041
Implicit	11.243	8.902	10.524

In summary, in Grade 4, congruent information was easier than incongruent information in all conditions. How congruent information was presented did not make a difference, but the manner in which incongruent information was presented did make a difference. Incongruent information was easier when presented explicitly. Level of staging made no difference.

In the seventh grade ANOVA, there was a significant main effect for degree of congruency ($F(1,63) = 32.19$, $p < .001$). Congruent information ($\bar{X} = 15.597$) was again easier than incongruent information ($\bar{X} = 13.313$) in all conditions. In this grade, there was a significant main effect for condition ($F(3,363) = 3.88$, $p = .01$) but no significant interaction. Thus, the conditions affected ability to process both congruent and incongruent information. Table 7 presents the congruent and incongruent means in the four different text conditions.

Table 7

Congruent and Incongruent Means in Different Text Conditions

Condition	Congruent	Incongruent
E Inc H/E Con L	16.688	14.750
E Inc L/E Con H	17.353	14.294
I Inc H/I Con L	13.687	11.250
I Inc L/I Con H	14.667	12.944

Simple specific comparisons showed a significant main effect for level of explicitness ($F(1,65) = 10.36$, $p<.01$) but no significant effect for level of staging. In Grade 7, therefore, congruent information was easier than incongruent information in all conditions and both types of information were easier when they were presented explicitly.

Discussion

The finding that the incongruent information was more difficult for both grade levels cannot be interpreted with confidence, since there is no assurance that the constructed materials are representative samples of congruent and incongruent information, which are domains that vary from individual to individual. Nevertheless, the incongruent information was presented simply and clearly, and the relative difficulty of this information is in keeping with the hypothesis that incongruent information is more difficult to process as a result of prior knowledge sources being in conflict with sources in the text.

In keeping with earlier work, the present study confirmed that explicit information is generally more likely to be used than is implicit information. The interaction between explicitness and congruency at the fourth grade level indicates, however, that an explicit statement of new information is particularly helpful when incongruent information must be processed. Apparently by the time they reach the level of seventh grade, most children have learned to note and accommodate to new information in the text that is incongruent with their prior knowledge,

even when that information is only implicitly stated. Incongruent information and implicit information remain relatively difficult to use, but there is no special difficulty about incongruent information that is only implicit.

The finding in the second study that incongruent information was more difficult than congruent information raised the possibility that large differences between congruent and incongruent scores found in the first study could be explained by saying that the non-accommodating children simply failed the more difficult items. However, an analysis based on the difficulty level of the congruent and incongruent questions missed by the 13 non-accommodating children suggests that this is an untenable explanation. As can be seen in Table 8, children in the non-accommodating group missed incongruent items that were generally easier than the congruent items they missed, even though incongruent items were harder overall.

Table 8

Mean Difficulty Levels of Congruent and Incongruent Items

(Based on all 5th and 6th grade students

	Congruent	Incongruent
All items	.71	.66
Items missed by non-accommodating children	.60	.62

When the items missed by these children were analyzed further, it appeared that the level of explicitness and level of staging of

incongruent information might be interacting with level of congruency to affect the comprehension of the incongruent information. Although incongruent items were much harder than congruent items overall for these children, incongruent items were even more difficult when implicitly stated and staged low. (See Table 9.) Thus, the same factors that generally affect middle-grade children affect the non-accommodating children.

Table 9

Mean Difficulty of Incongruent Items for all Fifth and Sixth Grade Children and for Non-Accommodating Children

Condition	All Children	Non-Accommodating Children
Explicit	.78	.42
Implicit	.56	.25
Staged High	.68	.35
Staged Low	.62	.29

The evidence that incongruent information is more difficult for middle grade children to process than congruent information suggests that this factor should be taken into consideration when making judgments about the difficulty level of texts presented to these children. The fact that incongruent information not explicitly stated is particularly difficult suggests the need to highlight the incongruent information in order to counteract for this difficulty, especially for the children who show greater difficulty in this area. It has been suggested that reliance on prior knowledge must be balanced by attention to orthographic and linguistic cues, (Stanovich, 1980).

The manner in which these children process linguistic cues and methods of training them to change their manner of processing are areas for further investigation.

References

Anderson, R.C. & Ortony, A. On putting apples into bottles: A problem of polysemy. Cognitive Psychology, 1975, 7, 167-181.

Bobrow, D.G., & Norman, D.A. Some principles of memory schemata. In D.G. Bobrow & A. Collins (Eds.), Representation and understanding: Studies in cognitive science. New York: Academic Press, 1975.

Bower, G., Black, J., & Turner, T. Scripts in memory for text. Cognitive Psychology, 1979, 11, 177-220.

Clark, H.H., & Clark, E.V. Psychology and language. New York: Harcourt Brace Jovanovich, 1977.

Clements, P. The effects of staging on recall from prose. In R. Freedle (Ed.), New directions in discourse processing. Norwood, N.J.: Albex, 1979.

Craik, F., & Lockhart, R. Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior, 1972, 11, 123-136.

Cromer, W. The difference model: A new explanation for some reading difficulties. Journal of Educational Psychology, 1970, 61, 471-483.

Frederiksen, C.H. Effects of context-induced processing operations on semantic information acquired from discourse. Cognitive Psychology, 1975, 7, 139-166.

Frederiksen, C. Inference and the structure of children's discourse. Paper presented at the Symposium on the Development of Discourse Processing Skills. Society for Research in Child Development. New Orleans, 1977.

Frostig, M., & Horne, D. The Frostig program for the development of visual perception. Chicago: Follett, 1964.

Goetz, E. Inferences in the comprehension and memory for text. (Tech. Rep. 49) Urbana,: University of Illinois, Center for the Study of Reading, July 1977. (Eric Document Reproduction Service, No. ED 150545).

Gough, P.B. One second of reading. In J.F. Kavanagh & I.G. Mattingly (Eds.). Language by ear and by eye. Cambridge, MA: MIT Press, 1972.

Guzak, F.J. Diagnostic reading instruction in the elementary school. New York: Harper & Row, 1972.

Halliday, M.A.K., & Hasan, R. Cohesion in English. London: Longman, 1976.

Hammill, D. & Bartel, N. Teaching children with learning and behavior problems. Boston, Allyn and Bacon, 1975.

Hildyard, A., & Olson, D.R. Memory and inference in comprehension of oral and written discourse. Discourse Processes, 1978, 1, 91-117.

Johnson, D., & Myklebust, H. Learning Disabilities: Educational principles and practices. New York: Grune & Stratton, 1967.

Kaufman, A.S. Intelligent testing with the WISC-R. New York: Wiley, 1979.

Kimmel, S. Children with a perseverative text interpretation strategy: The effect of text organization. Unpublished doctoral dissertation, Teachers College, Columbia University, 1981.

Kintsch, W. The representation of meaning in memory. Hillsdale, New Jersey: Erlbaum, 1974.

Kintsch, W. On comprehending stories. In M. Just & P. Carpenter (Eds.), Cognitive processes in comprehension. Hillsdale, New Jersey: Erlbaum, 1977.

Kintsch, W. On modeling comprehension. Educational Psychologist, 1979, 14, 3-14.

Maria, K., & MacGinitie, W. Prior knowledge as a handicapping condition. Paper presented at the Fourth International Colloquium in School Psychology, Jerusalem, July, 1980.

Marshall, N., & Glock, M. Comprehension of connected discourse: A study into the relationships between the structure of text and information recalled. Reading Research Quarterly, 1978-79, 14, 10-56.

Marslen-Wilson, W., & Welsh, A. Processing interactions and lexical access during word recognition in continuous speech. Cognitive Psychology, 1978, 10, 29-63.

Mattis, S., French, J.H., & Rapin, I. Dyslexia in children and young adults: Three independent neuropsychological syndromes. Developmental Medicine and Child Neurology, 1975, 17, 150-163.

Nix, D.H. Toward a systematic description of some experiential aspects of children's reading comprehension. Unpublished doctoral dissertation, Teachers College, Columbia University, 1977.

Otis-Lennon Mental Abilities Test, Elementary II Level, Form J. New York: The Psychological Corporation, 1967.

Pearson, P.D. The effect of background knowledge on young children's comprehension of explicit and implicit information (Tech. Rep. No. 116). Urbana, IL: University of Illinois, Center for the Study of Reading, 1979. (Eric No. ED 169 521)

Perfetti, C.A., & Lesgold, A.M. Discourse comprehension and sources of individual differences. In M. Just, & P. Carpenter (Eds.), Cognitive Processes in Comprehension. Hillsdale, New Jersey: Erlbaum, 1977.

Rumelhart, D.E. Toward an interactive model of reading. In S. Dornic (Ed.), Attention and performance (Vol. 6). Hillsdale, New Jersey: Erlbaum, 1977.

Spiro, R.J. Constructive processes in prose comprehension and recall. In R.J. Spiro, B.C. Bruce, & W.F. Brewer (Eds.), Theoretical issues in reading comprehension. Hillsdale, New Jersey: Erlbaum, 1980.

Spiro, R.J. Etiology of reading comprehension style (Tech. Rep. No. 124). Urbana, IL: University of Illinois, Center for the Study of Reading, 1979. (Eric No. ED 170 734)

Spiro, R.J., & Esposito, J. Superficial processing of explicit inference in text (Tech. Rep. No. 60). Urbana, IL: University of Illinois, Center for the Study of Reading, 1977. (Eric No. ED 150 545)

Spiro, R.J., & Smith, D. Patterns of overreliance on bottom-up and top-down processes in children. In press.

Spiro, R.J., & Tirre, W.C, Individual differences in schema utilization during discourse processing. Journal of Educational Psychology, 1980, 72, 204-208.

SRA Achievement Series, Levels E & F, Form 2. Chicago: Science Research Associates, 1978.

Stanovich, K. Toward an interactive-compensatory model of individual differences in the development of reading fluency. Reading Research Quarterly, 1980, 16, 32-71.

Thorndike, R.L. Dilemmas in diagnosis. In W. MacGinitie (Ed.), Assessment problems in reading. Newark, Delaware: International Reading Association, 1973, 57-67.

Tierney, R., Bridge, C. & Cera, M.J. The discourse processing operations of children. Reading Research Quarterly, 1978-79, 14, 539-573.

Warren, W.H., Nicholas, D.W., & Trabasso, R. Event chains and inferences in understanding narratives. In R.O. Freedle (Ed.) New directions in discourse processing. Norwood, New Jersey: Ablex, 1979.

Weaver, P. Comprehension, recall and dyslexia: a proposal for the application of schema theory. Bulletin of the Orton Society, 1978, 28, 92-113.

Weaver, P., & Dickinson, D. Story comprehension and recall in dyslexic students. Bulletin of the Orton Society, 1979, 29, 157-171.